

## Stratospheric Ozone: Past, Present, and Future

Ming-Taun L. eu

Earth and Space Sciences Division, Jet Propulsion Laboratory,  
California Institute of Technology, Pasadena, California 91109

### Abstract

Ozone, a molecule consisting of three oxygen atoms, surrounds the earth's atmosphere at an altitude of 10-50 km. Although the quantity of ozone is rather small, about 5 parts per million in air, it effectively provides a shield of earth surface from sun's ultraviolet radiation. Without a protective ozone layer in the atmosphere, animals and plants could not exist at all due to damage to DNA and thus affect future growth. Therefore, it is of the greatest importance to understand the processes that regulate ozone concentration.

Ozone in the atmosphere is formed through the dissociation of molecular oxygen by ultraviolet radiation from the sun. The association reaction between atomic oxygen and molecular oxygen then produces ozone. The removal mechanism of ozone in the stratosphere is much more complex. Currently, there are several catalytic cycles which include HOx, NOx, ClOx, BrOx, and others. The Antarctic ozone hole and Arctic ozone depletion are caused by heterogeneous chemical reactions on the surfaces of ice particles and sulfate aerosols, releasing high levels of free radical concentrations. New catalytic chain reactions, ClO-ClO and BrO-ClO, are responsible for the rapid loss of ozone in the polar regions.

Anthropogenic activities, such as the release of chlorofluoromethanes (CFC) from spray cans and the emissions from high-speed stratospheric aircraft (HSSA), have been of great concern over last two or three decades. The breakdown of CFC in the stratosphere produces chlorine atoms which remove ozone readily. Similarly, the plume from HSSA engines provides additional nitrogen oxides which also deplete ozone catalytically. Moreover, scientists are also concerned about the release of methyl bromide which is primarily used for agricultural purposes and fumigation. Therefore, it is of importance of studying the effect of man-made activities on our atmosphere.

Assessment for these atmospheric effects is currently managed by the World Meteorological Organization (WMO), the National Aeronautic and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the National Science Foundation (NSF). The research work is divided by three areas: field observations of trace gases and aerosols in the stratosphere, laboratory investigation of physical and chemical processes, and theoretical modeling and interpretation. The synergy of three areas is essential in understanding the atmospheric effects of CFC and HSSA.